Continuing Progress in 450mm Development

October 8, 2014
SEMICON Europa

Key Messages

- Program progress continues with broad Supplier support
- Technical results are excellent with few capabilities identified as challenges
- Wafer supply
  - Initial M1 grade wafers received
  - Notchless wafer standard ballot approved

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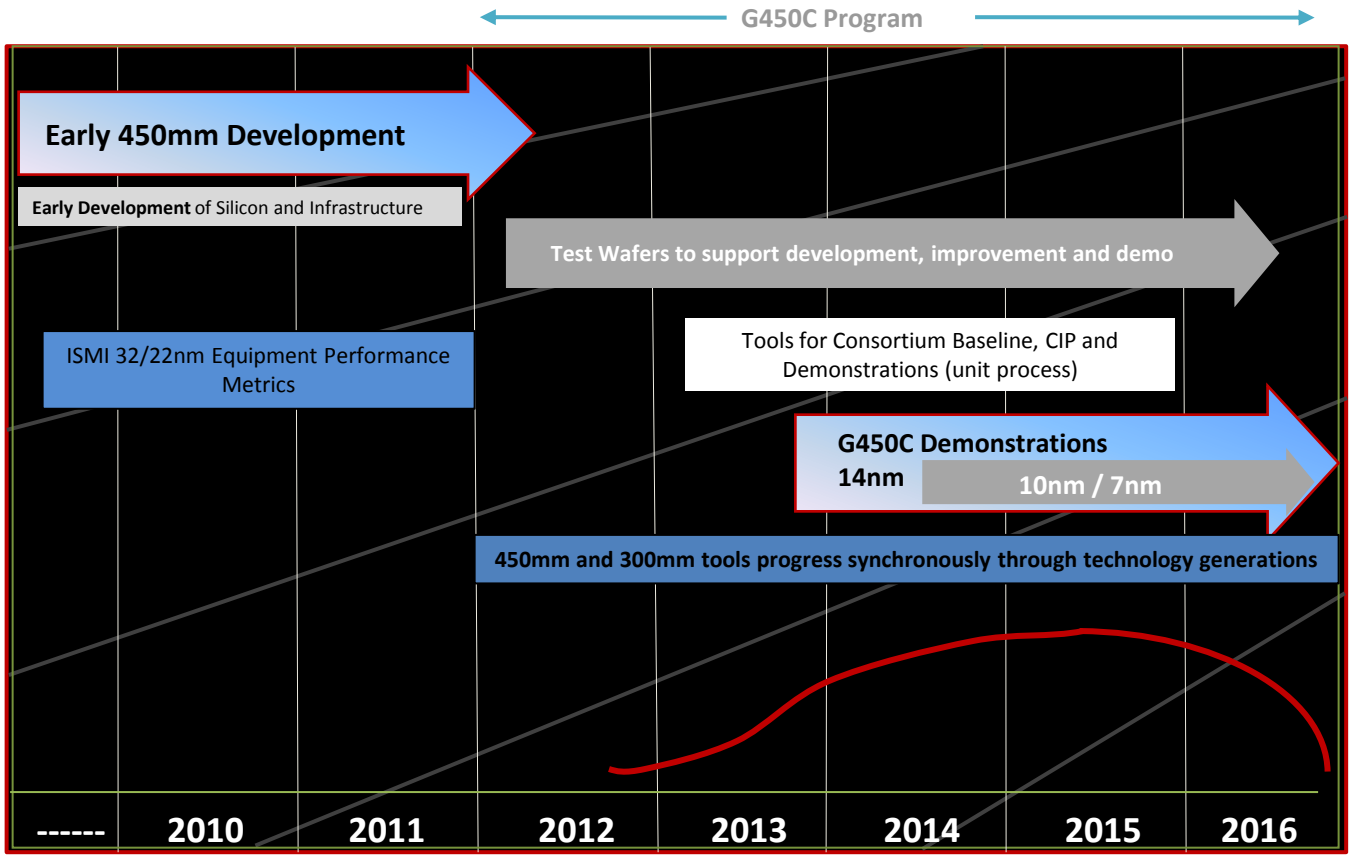
Development and Technology Intercept Targets



Likely profile of tool work scope from tool delivery to program completion

Full set (60+) of process and metrology tools and automation

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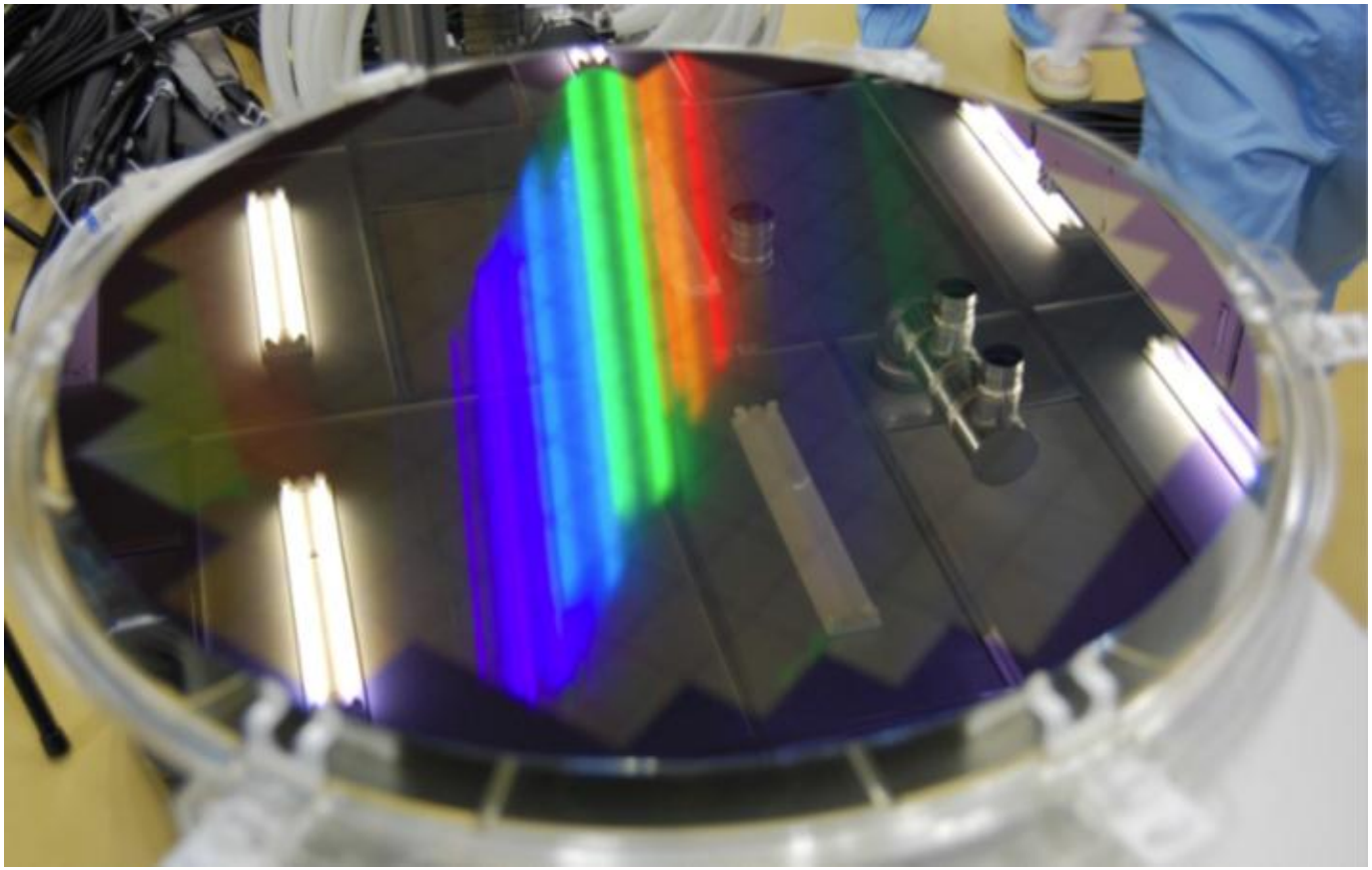

450mm 193i Patterned Wafer
Courtesy Nikon Corporation

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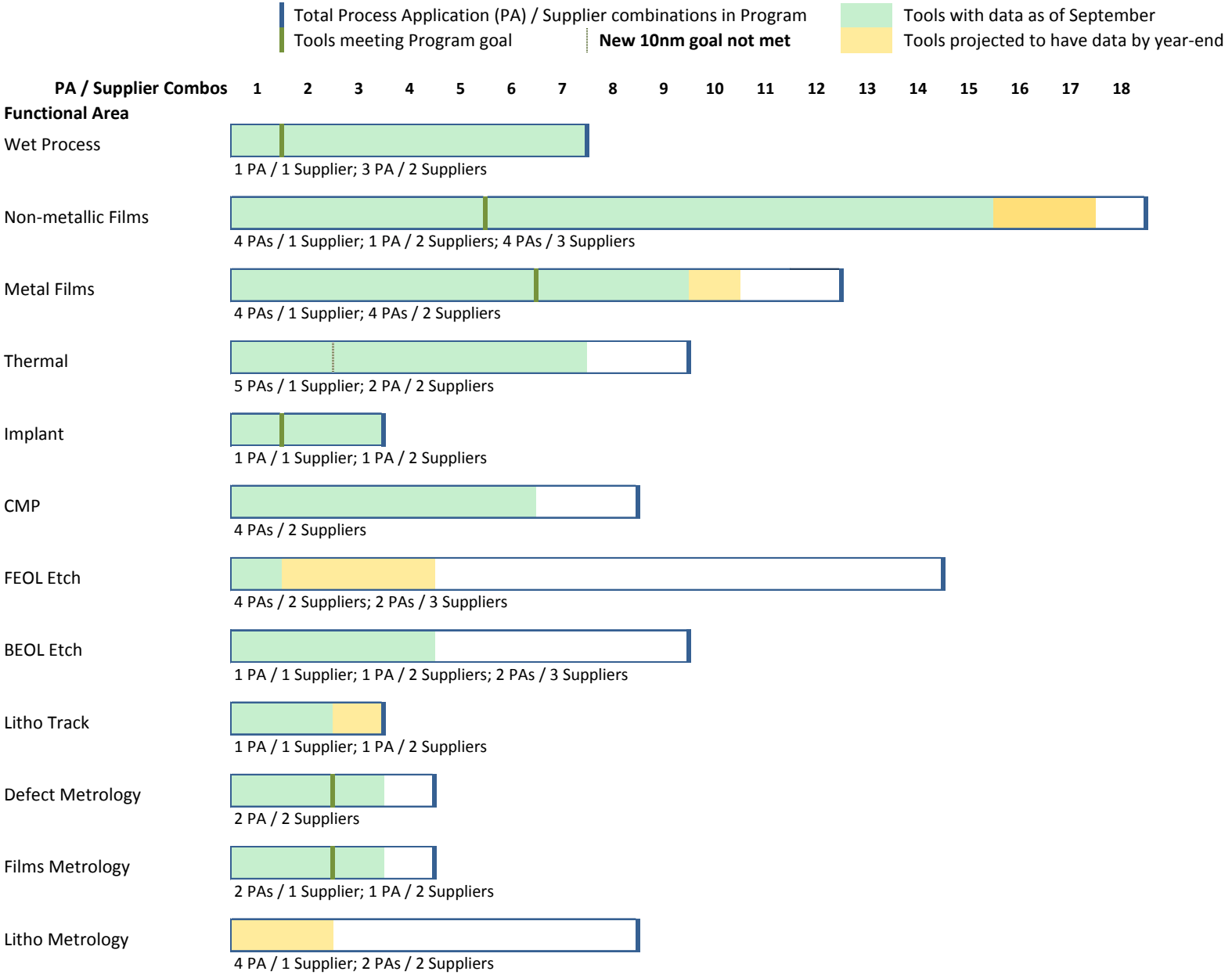
Process Capability Data Progress



EPM Refresh

- Sub-10nm EPM published as of SEMICON West
- Based on the uncertainties of sub-10nm process applications, modified metrics to include various process options
  - "Metal-plug" to replace "W-plug"; "barrier" instead of "Ti/TiN barrier"; "salicide" instead of "Ni salicide".
  - Modified epitaxy to include possible options beyond SiGe.
  - Include ALD option for various films.
- Instead of planar, FIN/STI structure will be the target structure
- Design rules and aspect ratio: referred but not fully aligned to ITRS roadmap. Modification based upon:
  - Inputs from member companies, suppliers and collaborating consortia
  - "Realistic and achievable" for tool qualification and CIP goals.

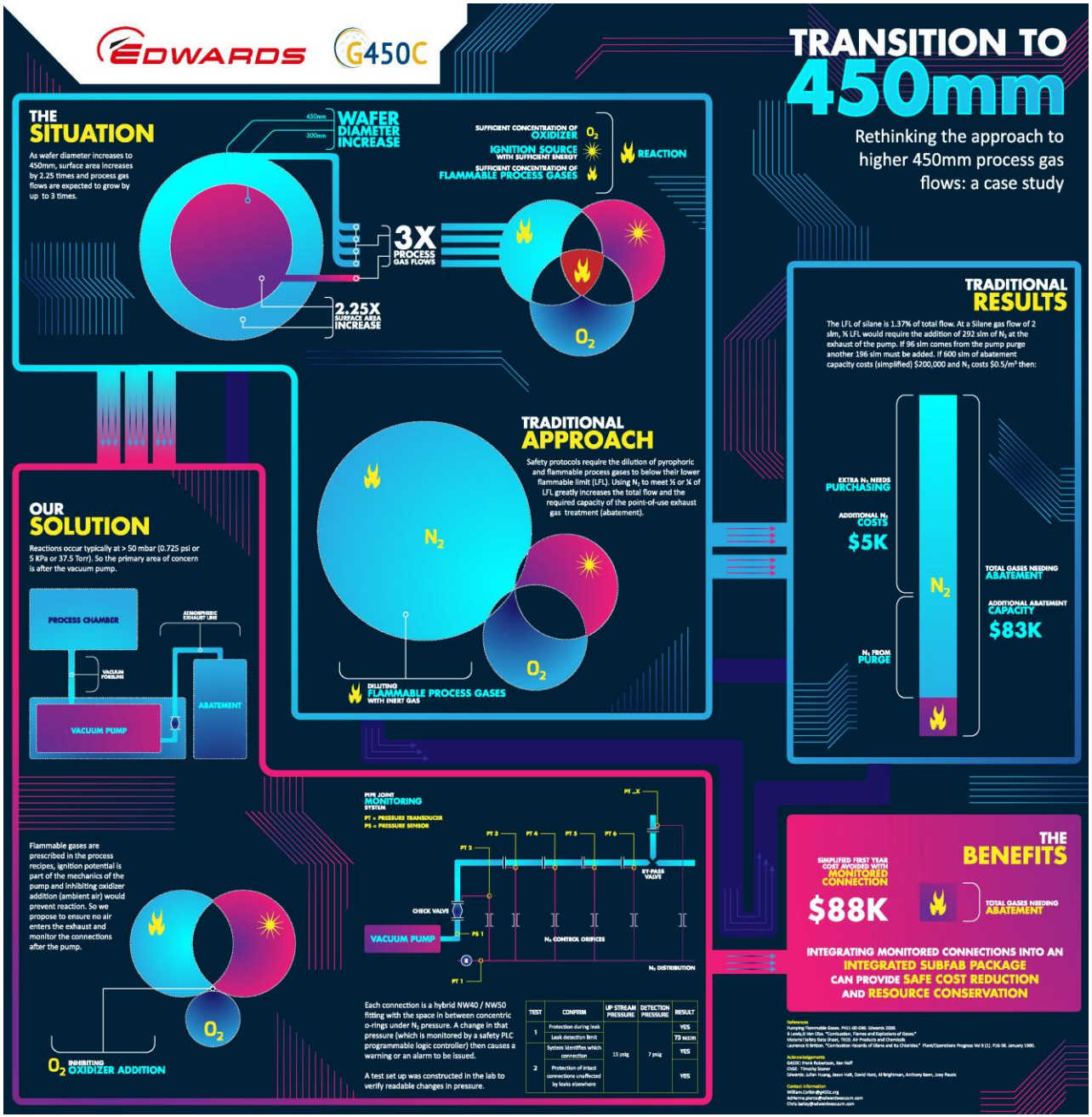
Thanks to EEMI450 Partners for Valuable Input!

G450C / EEMI450 / Metro450 Collaboration

- EEMI450 feedback (including IMEC and Suppliers) improved multiple parameters in sub-10nm Equipment Performance Metrics
- Joint planning on ASM furnace demo at G450C and Recif sorter demo at IMEC: standard methods / data exchange
  - Working with Metro450 to address slip measurement
  - Planning contamination analysis by Fraunhofer and TNO
- Planning fabrication of standard calibration wafer with Metro450

Ongoing Facilities / EHS work with F450C

- Pump / Abatement Green Mode
  - Communication network installed
  - Baseline fingerprinting under way
- Utilities use rates, effluent characterization
  - Sensors, data collection system installed
- GHG emissions
  - Expect to begin 4Q14
- He recycling
  - Defining project scope

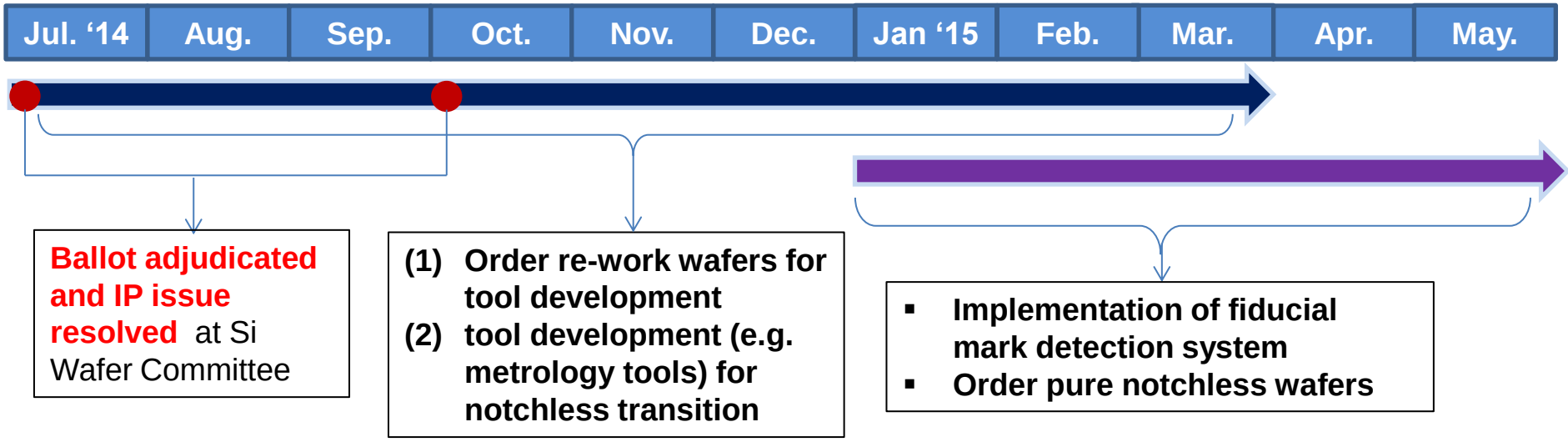


ASMC 2014

Addressing process gas use rate concern at 450mm that can benefit 300mm!

Notchless Wafer Timeline

- The notchless standards (M1 & M20) will be completed by October, 2014. The IP issue should be resolved at SEMICON Europa in October
- The notchless transition started already: some tools, e.g. KLA-T SP3 & WS3 and Nikon 193i, can take notchless wafers now
- The primary fiducial mark has been decided at 180° from the notch of re-worked wafers. G450C plans to order up to 3000 re-work wafers
- G450C plans to order up to 700 pure notchless wafers for future usage



450mm Standardization Support

- **SEMI Equipment Energy Savings Mode Task Force (aka "Green Mode")**
  - Developing fab-wide control framework → likely 2015 SEMI standards
- **SEMI 450mm Physical Interfaces & Carriers**
  - Working with ITG-J to eliminate 450mm carrier issues found at G450C
- **SEMI Defectivity Subcommittee**
  - Working to improve quality of consumables causing sub-10nm defects
  - Starting with 'O'-rings and valve seals
- **SEMI Wait Time Waste Task Force**
  - SECS log file data extraction for G450C offsite equipment
- **450mm Component Lift Working Group**
  - Component lift guidelines issued

Summary

- 450mm technical results are excellent
- 193i patterning capability demonstrated
- Notchless wafer standard approved
- Program progress continues
- Global collaboration important as ever

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